4.11 TERRESTRIAL NATURAL COMMUNITIES, WILDLIFE HABITAT, AND BIODIVERSITY

4.11.1 Terrestrial Natural Communities

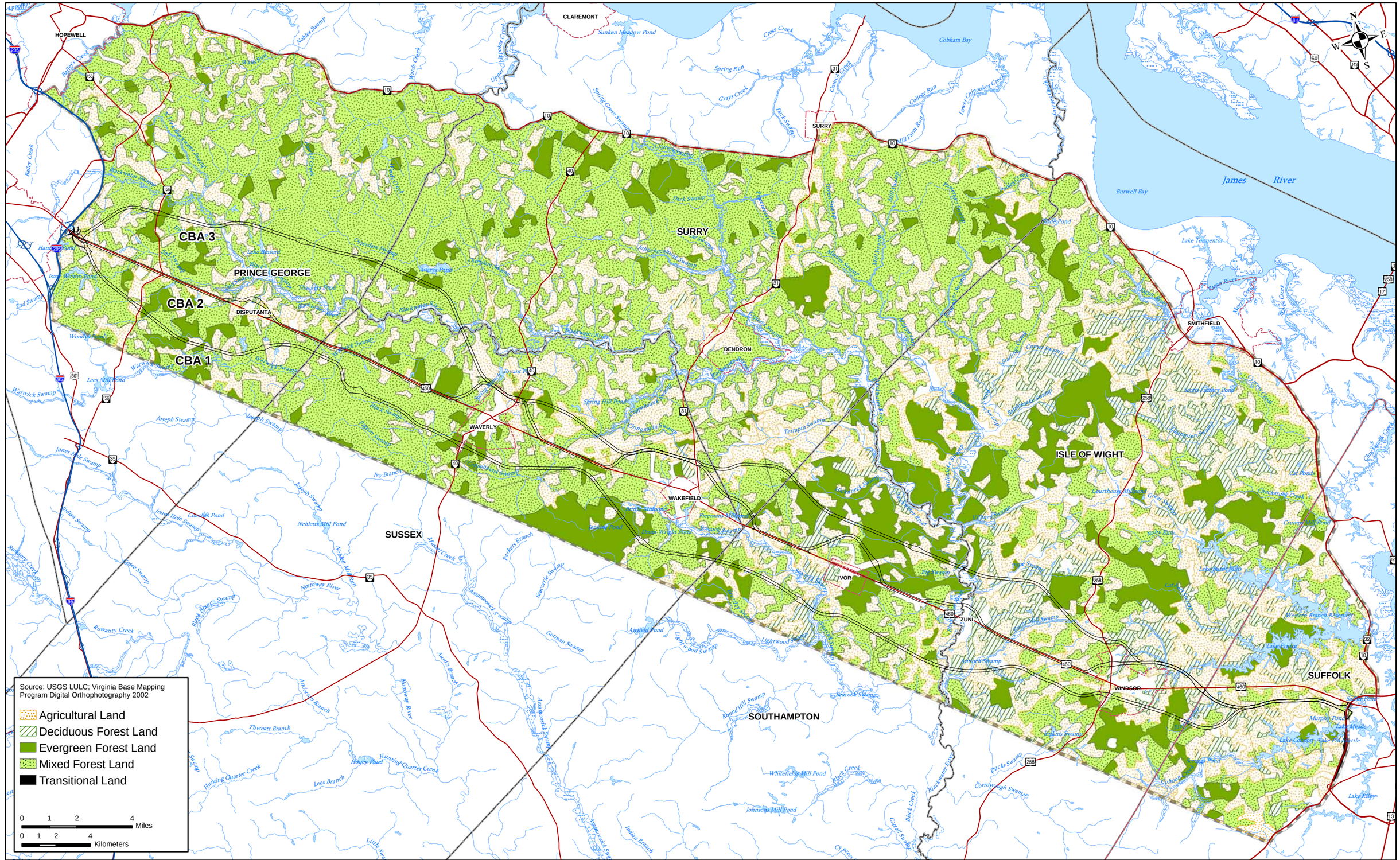
Figure 4.11-1 illustrates types of forest communities (as classified under the Anderson Land Use Classification) located within CBA assessment corridors. The majority of the forest lands in the study area are fragmented by agricultural lands, timbered clear-cuts, transportation corridors, utility easements, and, to a lesser extent, by residential and commercial development. Characteristics of these forest types along with their correlation to community types defined under the Natural Communities of Virginia: Classification of Ecological Community Groups: Second Approximation (VDCR, DNH, 2004) are provided in the Natural Resources Technical Report (VDOT, 2005). Forested wetlands are addressed as components of the riparian and aquatic ecological communities in sections 4.12 and 4.13 of this document.

Figure 4.11-1 also illustrates agricultural lands and transitional lands (primarily brush and old fields) located within CBA assessment corridors. A more-detailed discussion of ecological and habitat issues associated with agricultural lands and transitional lands is presented in the Natural Resources Technical Report (VDOT, 2005).

Construction of any of the CBAs would result in effects to the general ecology of forest lands, agricultural lands, and transitional lands. In addition, the wildlife habitat associated with these land cover types and the regional biodiversity would be affected by construction and operation of the roadway. The CBAs would affect terrestrial natural communities and associated wildlife habitat through conversion of existing land coverage to paved road surfaces and maintained right-of-way. This conversion would result in the permanent loss of wildlife habitat and could affect wildlife migration patterns. Using a 500-foot-wide Planning Corridor and a 230-foot-wide Design Corridor, terrestrial natural communities affected under each of the CBAs are provided according to land cover classification in Table 4.11-1.

Overall, CBA 3 would result in the greatest combined affects to terrestrial natural communities at 3,165 acres for the Planning Corridor and 1,709 acres for the Design Corridor. The 3,165 acres potentially affected within the Planning Corridor of CBA 3 comprise 0.72 percent of the total terrestrial natural communities occurring within the study area. The 1,709 acres potentially affected within the Design Corridor of CBA 3 comprise 0.39 percent of the total terrestrial natural communities occurring within the study area. Because CBA 2 would make use of a greater acreage of presently developed corridors (i.e., those along existing US 460), it would result in the least combined affects to terrestrial natural communities at 2,611 acres for the Planning Corridor and 1,159 acres for the Design Corridor. The 2,611 acres potentially affected within the Planning Corridor of CBA 2 comprise 0.59 percent of the total terrestrial natural communities occurring within the study area. The 1,159 acres potentially affected within the Design Corridor of CBA 2 comprise 0.26 percent of the total terrestrial natural communities occurring within the study area. Cumulative effects with respect to terrestrial natural communities of the region are discussed in section 4.19 (Cumulative Impacts). No National Forests, National Wildlife Refuges, or known unique or significant communities (“unique or state significant natural communities” of VDCR, Division of Natural Heritage terminology) would be affected by any of the CBAs.

It is reasonable to assume that a certain amount of minor effects to the general ecology and wildlife habitat values of forest lands, agricultural lands, and transitional lands will occur during implementation of programmed improvements associated wit the No-Build alternative; however, the current level of design for such improvements does not allow for quantification of such effects at this point in time.



Route 460 Location Study

FIGURE 4.11-1
TERRESTRIAL NATURAL COMMUNITIES

TABLE 4.11-1
POTENTIALLY AFFECTED TERRESTRIAL NATURAL COMMUNITIES

Alternative	Assessment Area	Forest Type (acres)								Agricultural Lands (acres)		Transitional Lands (acres)	
		Deciduous (Upland Hardwood)	% of total in study area	Evergreen (including planted pine variant)	% of total in study area	Mixed Hardwood/ Pine	% of total in study area	Total	% of total in study area		% of total in study area		% of total in study area
CBA 1	Planning Corridor	130.73	0.50	354.31	0.64	1,699.23	0.80	2,184.27	0.74	964.50	0.67	4.44	3.18
	Design Corridor	67.73	0.26	194.82	0.35	877.06	0.41	1,139.61	0.39	516.74	0.36	3.06	2.19
CBA 2	Planning Corridor	228.94	0.87	208.46	0.38	932.18	0.44	1,369.58	0.46	1,236.78	0.86	4.44	3.18
	Design Corridor	105.74	0.40	116.34	0.21	376.84	0.18	598.92	0.20	557.46	0.39	3.06	2.19
CBA 3	Planning Corridor	229.59	0.87	502.61	0.90	1,199.21	0.56	1,931.41	0.66	1,229.15	0.85	4.44	3.18
	Design Corridor	121.63	0.46	268.48	0.48	608.27	0.29	998.38	0.49	707.07	0.49	3.06	2.19
No-Build	not applicable	minor		minor		minor		minor		minor		minor	

4.11.2 Biodiversity

Figure 4.11-2 shows locations of potentially affected biodiversity-ranked (BRANK) communities. Figure 4.11-2 presents ranked terrestrial communities ("Conservation Sites" of DNH terminology) as well as ranked aquatic communities ("Steam Conservation Units" of DNH terminology, which are discussed in section 4.12 of this document). A complete listing of rare or unique terrestrial natural communities having a biodiversity ranking is provided in the Natural Resources Technical Report (VDOT, 2005).

Due to a long history of agricultural and sylvicultural activities, most uplands within the region are so highly fragmented that they afford limited contribution with respect to wildlife corridors. Riparian corridors, on the other hand, have been less altered over history and presently serve as components of several prominent wildlife corridors within the study area. For the purpose of this assessment, these prominent wildlife corridors have been considered to be those areas associated with contiguous forest communities and/or riparian zones which are wider than 0.5 miles throughout most of their length and are not presently bisected by major roadways or other impediments to migration. Prominent wildlife corridors informally identified as part of this study and their relationship to state-ranked biodiversity resources are shown on Figure 4.11-2. Prominent wildlife corridors generally greater than 0.5 mile in width consist of:

- an east-west riparian corridor along the middle to upper Blackwater River (extending roughly from the Town of Dendron westward into central Prince George County);
- an east-west riparian corridor formed by Otterman Swamp and the headwaters of Cypress Swamp (extending roughly from the Town of Surry westward to the Blackwater River in central Prince George County);
- a north-south riparian corridor formed by the headwaters of Wards Creek, Otterman Swamp tributaries, a portion of Warwick Swamp, Black Swamp, and the headwaters of Assamoosick Swamp (extending roughly from north-central Prince George County southward into northwestern Surry County); and
- a north-south riparian corridor along Cypress Swamp (in central Surry County).

Several other prominent wildlife corridors generally having a width *less* than 0.5 mile are located within the study area. These narrower wildlife corridors consist of:

- a north-south riparian corridor formed by Green Swamp, Mill Swamp, and Rattlesnake Swamp (extending roughly from the Town of Surry southward to the Blackwater River in northern Southampton County); and
- a north-south riparian corridor along the lower Blackwater River (extending roughly from the Town of Dendron southward to the City of Franklin).

Biodiversity of a particular area or region is determined by a number of complexly inter-related factors. For the purpose of this assessment, general effects to overall biodiversity is expressed as a function of (1) the number of acres of terrestrial natural communities affected, (2) the number of BRANK sites that would be encroached upon, and (3) the number of prominent wildlife corridors that would be further dissected. Results of this assessment are presented in Table 4.11-2. Compared to other CBAs and the No-Build, CBA 3 would result in the greatest probable effects to biodiversity of the study area. By contrast, CBA 2 would result in the least probable effects to biodiversity of the study area.

TABLE 4.11-2
SUMMARY OF BIODIVERSITY EFFECTS

Alternative	Absolute and Relative Effects						Relative Effect (No. units)
	Effects on Terrestrial Natural Communities (Acres)	Percent of Total	BRANK site Encroachment (No.)	Percent of Total	Wildlife Corridor Bisections (No.)	Percent of Total	
CBA 1	3,153	*0.35*	4	*0.36*	2	*0.29*	1.00
CBA 2	2,611	*0.29*	3	*0.28*	1	*0.14*	0.71
CBA 3	3,165	*0.36*	4	*0.36*	4	*0.57*	1.29
Total Effects	8,929		11		7		

Right-of-way necessary for a new or widened highway would convert a portion of forest lands and agricultural lands to successional herbaceous and shrub communities. This conversion will lead to the inadvertent creation of edge habitat that will intrinsically have certain attractive values to wildlife (particularly for bird species). Although edge habitat can beneficially contribute to biodiversity and provide certain wildlife habitat functions, its inadvertent creation along rights-of-way must be weighed against potential adverse effects (such as increased probability and frequency of wildlife vehicle collisions).

4.11.3 Migratory Birds Relying on Terrestrial Habitat

Eleven FWS-listed "Species of Management Concern" which rely entirely or primarily upon terrestrial habitat have been reported to occur within the study area (Virginia Department of Game and Inland Fisheries, VAFWIS, accessed April 2005). Only one of these terrestrial "Species of Management Concern", the grasshopper sparrow (*Ammodramus savannarum pratensis*) is reported to be dependant upon vulnerable or restricted habitat. The loss of habitat for the grasshopper sparrow is an effect that can be directly attributed to roadway construction and indirectly attributed to development potentially induced around interchanges, whereas listing of the other ten terrestrial "Species of Management Concern" is attributed to factors which cannot be shown to be associated with roadway projects. The grasshopper sparrow is a statewide summer resident which breeds statewide (Virginia Society of Ornithology, 1987). The species is usually encountered in xeric (drier) pastures sometimes interspersed with weeds or shrubs (Hamel, 1992; Rising, 1996), or in abandoned fields and stable grassland (Virginia Department of Game and Inland Fisheries, 2005). Despite availability of habitat, abundance of the grasshopper sparrow fluctuates from year to year for unknown reasons (Sprunt, 1954). Adverse management practices which could be contributing to fluctuations in abundance include (1) the application of pesticides and herbicides and (2) haying and mowing operations during times of residency (Virginia Department of Game and Inland Fisheries, 2005). Management practices identified as being beneficial to the species include (1) restricting or regulating human uses of habitat, (2) use of prescribed or controlled burns to create or maintain habitat during periods on non-residency, (3) controlling the grazing of domestic livestock, and (4) use of haying and mowing to create or maintain habitat during periods on non-residency (Virginia Department of Game and Inland Fisheries, 2005).

CBA 2 and CBA 3 would result in comparable direct losses of agricultural lands and transitional lands, some of which could serve as suitable habitat for the grasshopper sparrow (1,237 acres and 1,229 acres, respectively). By contrast, CBA 1 would result in the direct loss of 965 acres of agricultural lands and transitional lands, some of which could serve as suitable habitat for the grasshopper sparrow. With respect to intensity of effects, none of the CBAs would result in severe direct effects to suitable habitat on a regional basis (ranging between 0.67 percent and 0.86 percent of total agricultural lands and transitional lands within the study area). Cumulative effects with respect to terrestrial natural communities of the region are discussed in section 4.19 (Indirect Effects and Cumulative Impacts).

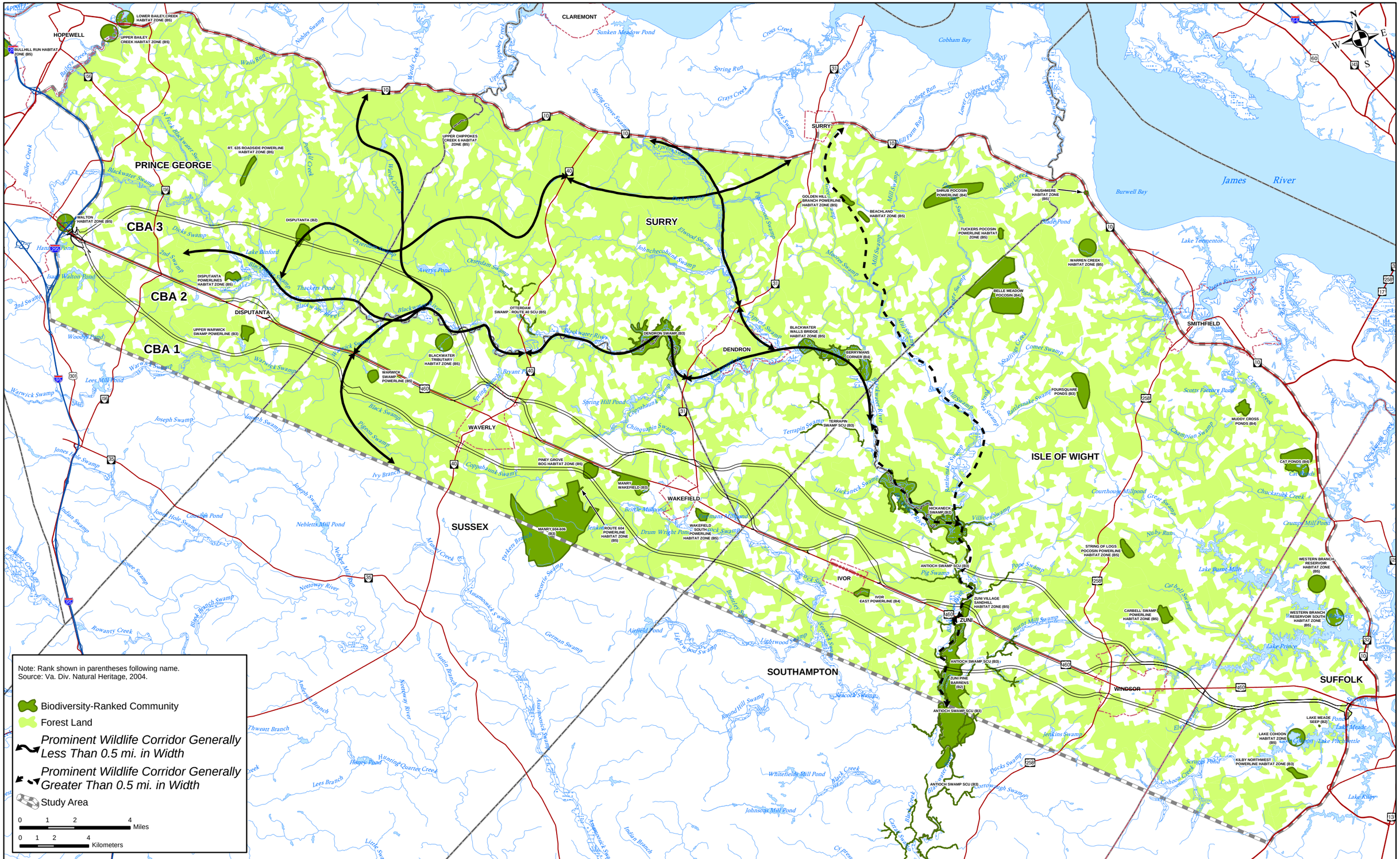


FIGURE 4.11-2
BIODIVERSITY RANKED SITES AND PROMINENT WILDLIFE CORRIDORS

4.11.4 Mitigation

Cut and fill will be minimized to the extent practicable to ensure structural stability of the roadway and associated structures (using steeper-than-conventional slopes in environmentally sensitive areas, etc.). In addition, the implementation of best management practices (BMPs) for erosion/sediment control and abatement of pollutant loading will minimize secondary impacts to adjoining communities and habitat. Best management practices and invasive species control measures will be implemented to control colonization and spread of terrestrial invasive plants.

Provision of right-of-way for a new or widened highway would convert a portion of forest lands and agricultural lands to successional herbaceous and shrub communities. As part of this conversion, features designed to intentionally provide wildlife habitat or to attract wildlife will not be included in vegetation establishment/management plans developed for rights-of-way; however, it is anticipated that provision of maintained rights-of-way will lead to the creation of forest edge habitat that will intrinsically have certain values to wildlife habitat (particularly for bird species). To mitigate potentially adverse effects associated the inadvertent attraction of wildlife to newly created edge habitat along rights-of-way, VDOT will consider excluding landscape options that would intentionally provide wildlife habitat or attract wildlife (such as the use of plant species having high wildlife feeding values) from vegetation establishment/management plans developed for rights-of-way and wildlife fencing will be installed as needed. As discussed below, the use of persistently tall herbaceous vegetation and shrubs will be considered to minimize the frequenting of rights-of-way by the grasshopper sparrow.

Where feasible, passageways for terrestrial and riparian wildlife will be maintained beneath proposed bridges and certain elevated structures to help minimize effects of wildlife corridor bisection. Fencing will be employed to help minimize vehicle-wildlife collisions and to help direct wildlife towards maintained passageways. Practicable mitigation measures to minimize effects of habitat fragmentation will be further developed and designed prior to preparation of permit applications.

In its 9 December 2004 letter to FHWA, FWS recommended that direct effects to terrestrial natural communities and associated adverse effects upon regional biodiversity be mitigated through such means as restoration or enhancement of habitat, conservation initiatives, riparian corridor restoration, establishing vegetated buffers along field edges for edge habitat, and upland forest corridor restoration. In addition, VDOT will consider preservation or creation of upland buffers around compensatory wetland mitigation sites – a measure that would also contribute to overall biodiversity. Use of such buffers would be evaluated during later phases of project design and permitting. Payment-in-lieu to VDGIF for purchase of lands for enlargement of Wildlife Management Areas will be considered as one means of mitigation that could be reasonably pursued under the current regulatory environment. Such acquisition would be targeted at restoring, enhancing, or preserving forest lands critical to establishment or maintenance of wildlife corridors and migratory bird habitat within the region, as set forth in the "Resource Protection" mission goal of the *Blueprint for the Future of Migratory Birds: Migratory Bird Program: Strategic Plan 2004-2014* (U.S. Dept. of the Interior, Fish and Wildlife Service, 2004). Mitigation measures such as expanding the size of existing Natural Area Preserves (NAPs) also will be considered in cooperation with VDCR-DNH and The Nature Conservancy.

With respect to management practices for the grasshopper sparrow:

- Landscaping options which would restrict or discourage the species from frequenting rights-of-way (thereby reducing the probability and frequency of wildlife/vehicle collisions) would be developed during late phases of project design and permitting. This could include methods such as (1) minimizing mowing operations in critical areas and (2) planting of wildflowers and shrubs rather than grasses within the right-of-way.
- To avoid or minimize adverse effects to nearby habitat, stormwater management facilities would be designed to detain and/or treat pesticides and herbicides applied within the right-of-way.
- It is not reasonable to expect that VDOT could restrict or regulate human uses of habitat resulting from land development patterns indirectly associated with construction of a new or improved

transportation corridor. Instead, potential indirect effects upon suitable habitat would be the responsibility of localities under respective zoning ordinances and land use policies.

4.12 AQUATIC NATURAL COMMUNITIES, WILDLIFE HABITAT, AND BIODIVERSITY

This section addresses aquatic habitat associated primarily with waterways and water bodies; however, many of the species discussed in this section are also dependent on wetland habitats. Wetlands are discussed in greater detail in Section 4.13.

4.12.1 Aquatic Habitat and Benthic Communities

4.12.1.1 Direct Effects

Without appropriate mitigation, CBA stream crossings have the likelihood of increasing stormwater pollutant loading and locally altering stream hydrology and bottom characteristics at culvert and bridging locations. Stormwater pollutant loading projected for each of the CBAs is presented in the Water Quality Technical Report (VDOT, 2005). Linear feet of streams affected at stream crossings is discussed below and in section 4.13 (waters of the U.S.). Stream bed and stream banks would be affected within those stream reaches addressed below and in section 4.13. Any CBA that crosses an impaired or degraded stream (see the Water Quality Technical Report for affected Impaired Streams) has a relatively greater likelihood of adversely affecting in-stream and benthic communities due to the already stressed nature of these aquatic habitats.

No designated Essential Fish Habitat (NOAA Fisheries Service, website accessed March 2005), trout waters, or anadromous fish runs (VDGIF, VAFWIS; accessed February, 2005) are located within areas potentially affected by the CBAs. As discussed in section 4.15, a state-listed endangered fish species (the blackbanded sunfish or *Enneacanthus chaetodon*) occurs in Blackwater Swamp (near Route 156 in Prince George County), in Cypress Swamp (just upstream of Route 616 in Surry County), and in Harrells Millpond and the headwaters of Coppahaunk Swamp (just south of Route 460 between Wakefield and Waverly). With the exception of the blackbanded sunfish, fish assemblages of study area streams are comprised of generally abundant and commonly occurring warmwater game and non-game species typical to eastern seaboard streams. Without implementation of best management practices or effective mitigation measures, direct effects to warmwater fisheries of the study area would include loss of habitat and impediments to upstream/downstream migration. Within the Planning Corridor, loss of in-stream fish habitat (excluding wetlands) would range from 49,622 feet of stream under CBA 2 to 75,085 feet of stream under CBA 3. Within the Design Corridor, loss of in-stream fish habitat (excluding wetlands) would range from 24,062 feet of stream under CBA 2 to 37,361 feet of stream under CBA 3. Given the large amount of streams conducive to warmwater fisheries within the region, these direct losses are not considered severe. With proposed spanning of major stream crossings on structure and minimizing the amount of fill placed in the vicinity of stream crossings to only that amount required to assure integrity of placed fill and/or structures, direct effects to warmwater fisheries habitat or fish populations will be minor.

Three common species of freshwater mussels (the yellow lance, the eastern elliptio mussel, and the paper pondshell mussel), although sparsely distributed within the study area, occur within certain segments of the Blackwater River and its major tributaries (such as Terrapin Swamp) (VDGIF, VAFWIS; accessed February, 2005) that would be crossed by a particular CBA. As previously stated, loss of stream bed within the Design Corridor would range from 24,062 feet of stream under CBA 2 to 37,361 feet of stream under CBA 3; however, due to high turbidity and presence of fine-grained sediment loading, only a small portion of affected stream bed serves as suitable habitat for mussels. Macrobenthic organisms are common to a wide range of streams within the study area, are not restricted to a particular type of stream bed, and would be negligibly affected by loss of stream bed proposed stream crossings.

Direct effects to aquatic organisms relying primarily on in-stream resources (i.e., habitat loss and degradation) are measured in terms of linear feet of streams affected within the Design Corridor. In the

absence of best management practices, implementation of a CBA would result in localized water quality degradation, habitat loss or degradation, and temporary to longer-term reductions in local populations. Expressed in terms of direct stream impacts to both perennial and intermittent streams within the Design Corridor, CBA 3 (at 37,361 feet of streams affected) would result in the greatest adverse effects to benthic and in-stream resources within the study area. CBA 1 (at 32,865 feet of streams affected) would result in the next greatest adverse effects to benthic and in-stream resources within the study area, while CBA 2 (at 24,062 feet of streams affected) would result in the least adverse effects to benthic and in-stream resources within the study area.

Direct effects to organisms which rely primarily on riparian habitat can be related to acres of riparian zone within the proposed construction footprint. At 189 acres, CBA 1 will result in the greatest impacts to riparian habitat within the study area. Riparian habitat losses of 61 acres would result from implementation of CBA 2, compared to 129 acres for CBA 3. In addition, the permanent removal of riparian vegetation along affected stream segments would pose a long-term adverse effect upon in-stream habitat by reducing or eliminating sources of snags and course bottom detritus (Angermeier, et al, 2004).

Adverse effects upon aquatic communities during construction would include temporary increases in turbidity, temporary removal of riparian vegetation, short-term migration of mobile species away from disturbance, and incidental mortality contributing to temporary decreases in local populations.

It is reasonable to assume that minor effects to the general ecology and wildlife habitat values of aquatic resources will occur during implementation of the No-Build and TSM alternatives; however, these effects would be minor in comparison to CBA effects.

4.12.1.2 Indirect effects

A net increase in impervious surfaces resulting from the construction of a CBA could increase peak rates of discharge to receiving waters, thus resulting in an increased amount of stormwater to retain and treat. Increased volumes of stormwater resulting from any additional infrastructure or impervious surfaces does not, however, necessarily translate into worse water quality in receiving waters when appropriate best management practices are employed. Indirect effects to fish and fish habitat would include sediment and pollutant loading of streams during construction and operation of the facility. Aquatic biota (especially sessile fauna such as macrobenthic organisms and shellfish) could be adversely affected by direct highway construction impacts and aquatic ecosystem degradation. In the absence of erosion and sediment control measures and stormwater best management practices, these groups would be particularly vulnerable to stream siltation and pollutant loading both during construction and facility operation. Indirect effects will be avoided or minimized through implementation of erosion and sediment control plans and stormwater management facilities.

For the No-Build Alternative, minor increases in volumes of stormwater could result from additional infrastructure or impervious surfaces (such as provision of turning lanes, widening of shoulders, adjusting grades to improve sightlines, etc.).

4.12.1.3 Mitigation

Options for mitigation include restoration and/or reforestation of habitat, riparian communities, and floodplain or the establishment of vegetated buffers along field edges. Opportunities for restoration of degraded stream segments exist along many study area streams where adjoining agricultural practices have channelized once-natural stream channels, removed riparian vegetation, or resulted in acute siltation. Examples of stream segments where such restoration could occur are listed in section 4.13.2.2. Should one of the CBAs be selected, areas suitable for riparian buffer establishment will be further evaluated during the preliminary design phase for purposes of on-site habitat restoration. General and specific design measures and construction techniques that will be considered include fencing, stream channel enhancements, and stream access.

All effects to aquatic habitat would not necessarily be permanent. Highway crossings of streams can obstruct movements of aquatic organisms by altering flow velocity, stream geometry, and gradients. With the counter-sinking road crossing culverts, hydrologic connectivity can be maintained so as to reduce the mortality of and increase mobility of affected aquatic organisms. Additionally, culverts would be designed to maintain low-flow channels to minimize the possibility of obstructing aquatic organism passage. Post-construction restoration measures will be employed to restore temporarily affected habitat to pre-construction conditions, thereby allowing the recovery and re-establishment of locally affected aquatic and benthic populations. The success of this recovery will be enhanced by implementation and maintenance of both erosion and sediment control and stormwater best management practices. To avoid or minimize localized temporary siltation of streams, site-specific measures to monitor and control siltation would be required as part of VDOT contract bid packages and water quality permits issued by the regulatory agencies. At the design phase, VDOT will assess appropriate means to incorporate cost-effective features into the highway design.

4.12.2 Waterfowl and Other Water-Dependent Migratory Birds

4.12.2.1 Effects

One hundred sixteen water-dependent migratory bird species listed for protection under the Migratory Bird Treaty Act potentially exist within the study area (VDGIF, VAFWIS accessed 2004) (see Appendix A of the Natural Resources Technical Report (VDOT, 2005)). Of these 116 species, seven have been listed as "Species of Management Concern" for the northeast region (FWS, 1995). Of the seven water-dependent "Species of Management Concern" within the region, the "reason for concern" for one of these species (the least bittern or *Ixobrychus exilis*) is reported to be "dependence on vulnerable or restricted habitats". For the remaining six species, the FWS-designated "reason for concern" is not directly linked to habitat loss.

The least bittern is a common transient and uncommon summer resident of the Coastal Plain of Virginia (Virginia Society of Ornithology, 1979). The species is usually encountered in freshwater marshes, but may also be found in brackish and salt water marshes (Harrison, 1975). Preferred habitat is wetlands with dense, tall emergent vegetation over relatively deep water interspersed with patches of open water (Schneider and Pence, eds., 1992). This preferred habitat most closely correlates to palustrine emergent wetlands and palustrine scrub-shrub wetlands of the study area. Adverse management practices which adversely affect habitat include (1) marsh drainage and other activities leading to loss of marsh lands, (2) pollution, (3) application of pesticides, and (4) development activities (Terres, 1982). Management practices identified as being beneficial to the species include (1) creating, maintaining, and protecting wetlands; (2) controlling sedimentation; (3) controlling pollution; (4) restricting and regulating human use of habitats; and (5) creating and maintaining ponds (Virginia Department of Game and Inland Fisheries, 2005).

Considering palustrine emergent and scrub-shrub wetlands as suitable habitat for the least bittern, CBA 3 would affect 40.95 acres, CBA 1 would affect 36.57 acres, and CBA 2 would affect 35.82 acres of suitable habitat. With respect to severity of effects, none of the CBAs would result in significant direct effects to suitable habitat on a regional basis (ranging between 0.24 percent and 0.26 percent of total emergent and scrub-shrub wetlands within the study area). Cumulative effects with respect to terrestrial natural communities of the region are discussed in section 4.19 (Indirect Effects and Cumulative Impacts).

4.12.2.2 Mitigation

With respect to management practices for the least bittern:

- Beyond those wetland avoidance and minimization measures identified as part of this planning study, other practicable means to avoid and further minimize effects to wetlands will be implemented during later phases of project design and permitting. Suitable habitat would be mitigated at a 1:1 ratio for emergent wetlands and 1.5:1 for scrub-shrub wetlands.

- To avoid or minimize adverse effects to nearby habitat, stormwater management facilities would be designed to detain and/or treat (1) pesticides and herbicides applied within the right-of-way, (2) highway-related pollutants conveyed in stormwater, and (3) sedimentation resulting form construction activities and facility operation.
- Means to restrict or limit landscaping activities having the potential of attracting the species to the highway corridor (thereby resulting in a higher probability of mortality due to wildlife/vehicle collisions) would be developed during late phases of project design and permitting. This could include methods to discourage the species from frequenting the highway corridor, such as (1) minimizing mowing operations in critical areas and (2) planting of wildflowers and shrubs rather than grasses within the right-of-way.
- It is not reasonable to expect that VDOT could restrict or regulate human uses of habitat resulting from land development patterns indirectly associated with construction of a new or improved transportation corridor (see section 4.19). Instead, potential indirect effects upon suitable wetlands habitat would be the responsibility of (1) localities under respective zoning ordinances and land use policies and (2) the Corps of Engineers under section 404 of the Clean Water Act, and (3) DEQ under the Virginia Water Protection Permit Program.

4.12.3 Biodiversity of Aquatic Habitat

4.12.3.1 Effects

Biodiversity-ranked aquatic communities known as Stream Conservation Units (SCUs) designated by Virginia DNH are discussed in more detail in the Natural Resources Technical Report (VDOT, 2005). Potentially affected SCUs are presented in Table 4.12-1 and are shown in Figure 4.11-2. The Antioch Swamp SCU is classified as a resource of "moderate significance" by DNH because it serves as a "good" example of a community of its type and exhibits "excellent to good" occurrence of state-rare species.

Table 4.12-1
BIODIVERSITY RANKED STREAM CONSERVATION UNITS AFFECTED

SCU AFFECTED	BIODIVERSITY RANKING	ENCROACHING ALTERNATIVE(S)
Antioch Swamp	B4 (Moderate Significance)	CBA 1 (3 Crossings) CBA 2 (1 Crossing) CBA 3 (3 Crossings)

Source: Virginia Department of Conservation and Recreation, Division of Natural Heritage, November 2002; PB, 2002.

Compared to adjoining uplands (which have been altered over a long history of agricultural and sylvicultural activities), riparian corridors have been less altered over history and presently serve as components of several prominent wildlife corridors within the study area. In all cases, these prominent wildlife corridors are associated with contiguous forest communities. Prominent wildlife corridors informally identified as part of this study and their relationship to state-ranked biodiversity resources are shown on Figure 4.11-2.

Biodiversity of a particular stream system or stream segment is determined by a number of complexly inter-related factors. For the purpose of this assessment, general effects to regional aquatic biodiversity is expressed as a function of (1) linear feet of perennial streams affected, (2) linear feet of intermittent streams affected, (3) the number of SCU crossings, (4) the number of prominent riparian wildlife corridors that would be further dissected, and (5) the acreage of riparian zone that would be affected. Results of this assessment are presented in Table 4.11-2.

TABLE 4.12-2
SUMMARY OF BIODIVERSITY EFFECTS (PLANNING CORRIDOR)

Alternative	Absolute and Relative Effects										Relative Effect (no units)
	Perennial Streams Affected (feet)	Percent of Total	Intermittent Streams Affected(feet)	Percent of Total	Number of SCU Crossings	Percent of Total	Number of Riparian Corridors Bisected	Percent of Total	Riparian Zone Affected (acres)	Percent of Total	
CBA 1	20,406	0.31	53,634	0.41	3	0.43	2	0.33	189	0.50	1.98
CBA 2	27,406	0.41	22,216	0.17	1	0.14	1	0.17	61	0.16	1.05
CBA 3	19,016	0.28	56,069	0.42	3	0.43	3	0.50	129	0.34	1.97
Total (Additive Effects)	66,828	n/a	131,919	n/a	7	n/a	6	n/a	379	n/a	n/a

Compared to other CBAs and the No-Build, CBA 1 would result in the greatest probable effects to biodiversity of the study area, although the difference with CBA 3 is negligible. By contrast, CBA 2 would result in the least probable effects to biodiversity of the study area.

4.12.3.2 Mitigation

A riparian ecosystem consists not only of the stream channel and banks, but also the adjacent floodplain and transitional upland fringe (USDA, NRCS, 1998). Mitigation of adverse effects upon regional biodiversity through riparian corridor restoration would have limited long-term effectiveness unless chronic land uses can be restricted or regulated within the entire watershed and unless *all* key elements of the riparian ecosystem (including headwaters) are afforded protection under the restoration plan (USDA, NRCS, 1998). Considering the fact that the vast majority of lands comprising the various watersheds within the study area are privately owned and, considering the infeasibility of VDOT being able to acquire expanses of land large and contiguous enough to render stream restoration effective, this option is not considered viable through direct implementation by VDOT. Should a CBA be selected, payment in-lieu into a comprehensive landscape management program administered by a local Soil and Water Conservation District, the Natural Resources Conservation Service, the Virginia Department of Conservation and Recreation, or The Nature Conservancy would instead be pursued as a form of mitigation which would benefit regional biodiversity. Preferred areas for mitigation efforts involving riparian corridor restoration and/or preservation are the Antioch Swamp SCU (located just upstream and downstream of Route 460 on the Blackwater River), the Hickaneck Swamp Conservation Site (located just upstream of Route 460 on the Blackwater River), and the Zuni Pine Barrens Conservation Site (located just downstream of Route 460 on the Blackwater River). These areas are characterized by relatively high species richness, support populations of several state-listed species, and contain stream segments that are impaired due to high fecal coliform counts and sedimentation resulting largely from agricultural runoff. Restoration and/or preservation would also be consistent with the "Resource Protection" mission goal of the *Blueprint for the Future of Migratory Birds: Migratory Bird Program: Strategic Plan 2004-2014* (U.S. Dept. of the Interior, Fish and Wildlife Service, 2004).

4.13 WATERS OF THE U.S., INCLUDING WETLANDS

Within the study area, "waters of the U.S." include waterways (perennial streams, intermittent streams, and certain ephemeral streams), water bodies (reservoirs and certain ponds), wetlands, and deepwater habitat (those portions of waterways and water bodies deeper than 6.6 feet). More-detailed discussion of waters of the U.S. is found in the *Natural Resource Technical Report* (VDOT, 2005).

To reduce impacts at major stream crossings, a number of bridges have been proposed. Estimating bridge locations and spans lengths during preliminary engineering is difficult, lacking detailed hydraulic and survey data. However, an approach was used that involved estimating bridge locations and minimum hydraulic openings to accommodate estimated 100-year storm flows. At the bridges identified, locations of seasonally flooded wetlands were reviewed and bridge lengths increased accordingly to further reduce impacts . These prospective bridge locations are presented in Table 4.13-1.